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ABSTRACT

The purpose of this study was to investigate what effect an inquiry focused environmental science course has on preservice teachers' environmental attitudes. Over a three semester period preservice elementary education students taking an environmental science course, which incorporated inquiry strategies along with national recommendations in environmental and science education, were given the actual form of the Science Laboratory Environment Inventory (SLEI) and the Environmental Issues Attitudes Defensibility Inventory (EIADI). Mean scores for the five scales of the SLEI questionnaire provided a learning environment profile which characterized this classroom as one with a high degree of student cohesiveness and open-endedness. Pre- and post-mean scores were analyzed for any significant change for EIADI data. Results showed no significant change in students' environmental attitudes but did show positive changes in students' defensibility scores. These findings are consistent with previous studies by Kinsey (1978), Kinsey and Wheatley (1980, 1984) and Yount and Horton (1992). Data collected in this study provide contradictory evidence to the claim that environmental education influences students' decision making processes and attitudes about the environment. Contains 11 references. (Author/AA)

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CHARACTERIZING EFFECTIVE ENVIRONMENTAL EDUCATION AND IT'S IMPACT ON STUDENTS' ENVIRONMENTAL ATTITUDES.

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Abstract

The purpose of this study was to investigate what effect an inquiry focused environmental science course has on preservice teachers' environmental attitudes. Over a three semester period preservice elementary education students taking an environmental science course which incorporated inquiry strategies along with national recommendations in environmental and science education were given the actual form of the Science Laboratory Environment Inventory (SLEI) and the Environmental Issues Attitudes Defensibility Inventory (EIADI). Mean scores for the five scales of the SLEI questionnaire provided a learning environment profile which characterized this classroom as one with a high degree of student cohesiveness and open-endedness. Pre and post mean scores were analyzed for any significant change for the EIADI data. Results showed no significant change in students' environmental attitudes but did show positive changes in students' defensibility scores. These findings are consistent with previous studies by Kinsey (1978), Kinsey & Wheatley (1980,1984) and Yount & Horton (1992). Data collected in this study provide contradictory evidence to the claim that environmental education influences students' decision making processes and attitudes about the environment.

This last year has seen an increase in the debate over mandating environmental education (EE) in the public school curriculum. While some states, such as Wisconsin and Pennsylvania continue to have strong EE requirements, others have withdrawn their EE mandates citing inaccurate content and biases of the mandates towards liberal values. Central to the debate is the perception that environmental education attempts to influence decision making processes and attitudes about the environment. In light of these discussions and actions, the need for accurate information about the effects EE curriculum has on students' attitudes, values, and beliefs is essential for future decision making processes.

Previous studies involving the effects of environmental education on students' environmental attitudes has produced mixed findings (Tilbury, 1992). One set of studies focused on preservice teachers who had taken environmental education or environmental science courses. Koballa and Chen (1993) found there to be some short and long-term changes in elementary education students' intention and attitudinal beliefs about the environment using anecdotal messages, however, they found no short or long-term changes in intention or attitudes using data-summary

messages. McClure and Bell (1990) used concept maps as an assessment tool and reported some change in preservice students' proposition characteristics after completing an environmental education course. Another set of studies involved the Environmental Issues Attitudes Defensibility Inventory (EIADI) which measures students' assimilation and utilization of knowledge, values, and decision making processes (Kinsey & Wheatley, 1980). One study using the EIADI in the early 1980's (Kinsey & Wheatley, 1984) found that students did not change their attitudes as a result of environmental studies courses, but did show significant increases in the amount of supporting evidence utilized in an attitude decisions (defensibility). Yount and Horton (1992) reported no significant changes in non-science majors environmental attitudes as well, but did show that students with higher cognitive reasoning scores were more prone to increase defensibility. Recommendations from Yount and Horton's studies included changing the environmental studies course from being a memorization course to one that offer students the opportunities to synthesize and apply knowledge to new situations. Brown (1996) completed a study which assessed a course modeling these recommendations along with adding three essential pieces to an environmental education learning experience; conceptual understanding through the use of the learning cycle, values clarification, and action or service learning. Findings showed changes in students' attitudes about science in the category of social implications of science, but did not look specifically at environmental attitudes and attitude defensibly.

In this study, the environmental model presented by Brown was reassessed looking specifically at environmental attitudes and attitude defensibility. The guiding questions for the study were: What learning environment profile characterizes an inquiry focused environmental science classroom? Are students' attitudes and defensibility regarding environmental issues effected by an inquiry focused environmental science course?

Methods

Procedure

This study used a one-group pretest-post test design. Over a three semester period students taking an environmental science course (See course description below) were asked to complete the Environmental Issues Attitudes Defensibility Inventory (EIADI) at the beginning and end of the semester. In addition, students completed the actual form of the Science Laboratory Environment Inventory (SLEI) midway through the semester (For more information about both instruments see instrument description below). The number of students involved in the final analysis was 121. Ninety five percent of these students were elementary education majors ranging from sophomores to post baccalaureates. Prerequisites for the course included the completion of two semesters of science course work involving content in biology, geology, physics, and chemistry.

Description of Instruments

To help characterize the learning environment studied the Science Laboratory Environment Inventory (SLEI) questionnaire was used. The SLEI has evolved from faculty and staff questions related to the maintenance and staffing of laboratories, cost effectiveness of laboratories, and students' positive or negative attitudes about laboratory class activities. The instrument, developed in Australia and tested internationally, evaluates student views of their actual laboratory environment and student preferences in a laboratory setting (Fraser, Giddings, and McRobbie, 1989). Five different dimensions are evaluated from the student's perspective: cohesiveness, open-endedness, integration, rule clarity, and material environment. There are two versions of the test, an actual and a preferred form. In the actual form, students are asked what they perceive is actually happening in the science laboratory at that time. The preferred form asks students what they would prefer the science laboratory to be like. In this study, the actual form was used to assess how students perceived the environmental science learning environment. This 35 item questionnaire rates students' responses on a five-point, Likert-type scale, ranging from 'almost never' to

'very often.' Because there are no right or wrong answers, different versions of the test were not needed.

To measure students' environmental attitudes the Environmental Issues Attitudes Defensibility Inventory (EIADI) was used. This questionnaire is composed of two parameters, students' environmental attitudes and informational supports (defensibilty) associated with the measured attitudes. To measure the parameter of environmental attitudes, four narratives are presented involving environmental dilemmas. Each dilemma has a topic focus involving one of the following: population and food resources, habitat destruction/biodiversity, pesticides, and landuse. A value judgment is made regarding each narrative by choosing a number ranging from 1 (anti-environmental) to 4 (pro-environmental). Following each narrative students are asked to choose a set of criteria they considered when making their decision regarding the dilemma. This criteria is used to determine the informational supports (defensibilty) parameter. The defensibilty score can be summarized in three ways. *Total defensibilty* is a weighted score for the considerations chosen, *count defensibility* is the sum of the number considerations chosen, and *intensity* is the total divided by the count. Researchers are still unclear as to which of the three measures best characterizes students' defensibilty. One additional parameter entitled *padding* measures whether students use random guessing. This parameter is used to validate student responses. For more details regarding each parameter and the scoring system used see Kinsey (1978).

Treatment

The environmental science course assessed was developed and taught as the last of a three course sequence of science content courses elementary education majors were required to take for their major. All courses in the sequence attempted to model effective teaching strategies in science including inquiry teaching, cooperative group learning, and alternative forms of assessment. The course structure incorporated two major conceptual frameworks for instruction. One was the 5-E's learning cycle (Trowbridge & Bybee, 1990) and the other was a model for teaching environmental education which incorporated understanding ecological concepts with

values clarification and action group projects (Van Matre, 1990). The course began with five different learning cycles using the themes of water, biological diversity, air, minerals, and toxic substances. The exploration and explanation phases of the cycles were focused on developing science content knowledge regarding the resources being investigated. The elaboration activities involved the students using critical thinking skills in analyzing the social context of the theme and identifying human attitudes and values associated with each resource studied. Following the learning cycles each student participated in a collaborative action group team which selected a local or regional environmental issue and studied the issue in both scientific and social contexts. Students developed skills in action strategies and critical thinking which lead to proposed solutions to the issue studied. Students then became actively involved in the implementation of these proposed solutions.

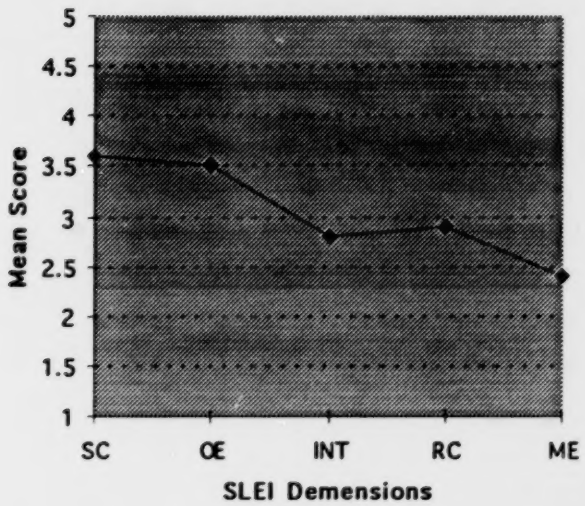
Results

SLEI Data

During the twelfth week of three different sixteen week semesters the actual form of the SLEI was given to all students taking the environmental science course. This questionnaire asked students to answer questions related to what they actually experienced in their science laboratory learning environment (Fraser, 1995). Questions on the SLEI instrument are divided into five scales: Material Environment (ME), Student Cohesiveness (SC), Open-endedness (OE), Integration (IN), and Rule Clarity (RC). Figure 1 shows the results of the mid-term responses to the actual form of the SLEI.

Figure 1

Scale Means for the Actual Form of the SLEI



Control and experimental group mean scores were based on a five-point Likert-type scale, ranging from 'almost never' to 'very often'. For example, if students viewed their laboratory class as having mostly open-ended activities, the score recorded would be a 5. If students viewed their laboratory class as having few open-ended activities, the score recorded would be a 1. The profile in Figure 1 are mean scores at the class level for preservice elementary students participating in the environmental science course being studied.

EIADI Data

During the first and last week of each semester studied all students enrolled in the environmental science course treatment course were asked to complete EIADI. This inventory consists of four value judgments students make regarding different environmental narratives and a series of statements students must choose which represent the information they used to make the value judgments. The narrative questions yield a values or attitude score and a defensibility score which is further

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broken down into four factors, total defensibility, count defensibility, intensity defensibility, and padding.

Table 1 shows the comparison of pretest and post test mean scores on the five parameters of the EIADI Questionnaire

Table 1

Comparison of the Pretest and Post Test Means of the Parameters of the Environmental Issues Attitude Defensibility Inventory

Parameter	pretest	posttest	t
Attitude	2.73 (.49)	2.74 (.54)	.111
Total defensibility	119.46 (26.51)	128.63 (23.71)	3.56**
Count defensibility	37.06 (9.59)	40.91 (8.36)	3.66**
Intensity defensibility	3.56 (1.74)	3.23 (.66)	-1.16
Padding	3.36 (2.41)	3.67 (4.66)	.445

Note. SD in parentheses.

** $p<0.01$.

Discussion

Results from the actual form of the SLEI show positive responses on all dimensions of the questionnaire except for material environment (See Figure 1). The two dimensions of student cohesiveness and open-endedness had the highest mean scores indicating that the course allowed students to interacted with each other in a positive manor in a less guided and more self directed learning environment. This matches well with observational data which indicated students often worked in cooperative groups which involved problem solving activities and laboratory experiments. In addition, students were frequently asked to develop their own approaches to answering questions and not given specific directions or procedures.

The scales of rule clarity and integration were above the mean average of 2.5 suggesting that students perceived a positive relationship between the lecture and laboratory learning environment and had a clear understanding of the rules in the class. The scale of material environment was below the mean of 2.5 suggesting students did not have a positive perception of the classroom materials and supplies. The profile in Figure 1 provides a snapshot of what this inquiry environmental education classroom looked like. It can be viewed as a learning environment that was open-ended in nature, involved students working positively in groups, the lecture was connected closely with the laboratory, a limited number of clear rules were given to students to follow, and inadequate laboratory equipment was used in the laboratory learning environment. In previous studies by Brown (1996) and Fraser (1995), high mean scores on the parameters of open-endedness and integration have been associated with more inquiry focused classrooms. The profile established for this learning environment suggests that this class was inquiry focused.

Results from student responses to the EIADI show students' environmental attitudes did not change after exposure to the learning environment described above (See Table 1, attitude parameter). These findings are consistent with previous studies by Kinsey (1978), Kinsey & Wheatley (1980,1984) and Yount & Horton (1992). One explanation for the consistent lack of measurable change in students' environmental attitudes as measured by the EIADI in this and earlier studies is that it may not be possible to effect student attitudes after completion of a single semester long course. Another explanation made by Yount and Horton (1992) was that the instructional approach common in past studies (lecture focused) might limit changes in students' environmental attitudes. It was proposed that by using more effective instructional strategies including critical thinking skills and inquiry instruction, students would be better able to discuss and reflect on environmental issues leading toward a change in students' environmental attitudes. These data do not support this rationalization and suggest that the teaching approach has little effect on students' attitudes when taking a single semester long course. It should be noted, however, that this study did not involve a direct comparison of two distinctly different instructional approaches and the

effect they had on student attitudes. Further studies should focus on formally comparing different instructional approaches and students' environmental attitudes.

While environmental attitude change was not measured, the parameter of defensibilty did show positive mean score gains. Significant differences were found in students' total defensibility and count defensibility (See Table 1). These data support the findings of Yount and Horton (1992), Kinsey (1978), and Kinsey and Wheatley (1980,1984) which showed student gains in defensibilty after taking environmental science or environmental studies classes. As mentioned earlier, defensibilty and count defensibilty refer to the amount of informational supports students used when making a value or attitude judgment. Kinsey and Wheatley (1984) interpret this positive defensibilty change as evidence that students have assimilated knowledge in a course. One underlying question this line of research has been investigating is the effect increased knowledge gain has on attitudes. While many researchers assume a positive relationship between knowledge and attitudes, studies using the EIADI have not shown a strong correlation between these two variables. Results from this study also show no positive attitude change associated with increased knowledge as measured by attitude defensibilty.

Conclusion

As mentioned in the introduction, environmental education has been under attack in the public schools for a number of reasons including the perception that environmental education attempts to influence decision making processes and attitudes about the environment. Data collected in this and previous studies using the EIADI instrument provide contradictory evidence to this claim. There appears to be consistent findings which suggest that students show no positive short-term attitudinal change regarding the environment after completion of a single semester environmentally focused course. Studies also show that students are using increased informational supports for their preexisting attitudes after completion of an environmental course. This suggests that students are developing a stronger knowledge base to support their environmental beliefs. These are positive findings for

those who are concerned that environmental education has a pro-environmental effect on students' attitudes.

From the environmental practitioners perspective this could also be useful information. In many states EE is taught in schools as a single set of lessons or outdoor experiences. By stating that short term exposure to environmental focused experiences has little effect on students' environmental attitudes and beliefs, one could claim the need for environmental education to be more extensively integrated throughout the curriculum if it is to have any lastly attitudinal effect. Likewise in the research involving students' environmental attitudes it is time to move beyond assessing the effect of a single semester long course. It is highly recommended that future research broaden the level of the study, possibly focusing on student attitudes in states with mandated EE curriculum versus non-mandated curriculum. This would provide information about the effects of a sustained educational experience on students' environmental attitudes and knowledge supports.

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